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ers cannot be overrated. We hope to mention the succeeding numbers of the series as they appear.

T. J. McC.

Lectures on the Geometry of Position. By *Theodor Reye*, Professor of Mathematics in the University of Strassburg. Translated and edited by Thomas F. Holgate, M. A., Ph. D., Professor of Applied Mathematics in Northwestern University. Part I. New York: The Macmillan Company. 1898. Pp., 248+xix.

Reye's *Geometrie der Lage* has long been a celebrated book in the English-speaking world, and has been made the foundation of many English expositions of the subject, notably that of Professor Henrici in the *Encyclopædia Britannica.* But it was not until last year that the work could be consulted by students ignorant of German. This was made possible by the translation of Professor Holgate, who deserves the thanks of all students of pure geometry for his laborious task.

Modern synthetic geometry is mainly a development of the nineteenth century. Prior to that time, and particularly in antiquity, geometrical discoveries, while important, were largely of a fragmentary and disjointed character, and not connected by systems of general principles; and, if we except the method of analysis attributed by Pappus to Plato, there was no general system of procedure by which new discoveries could be made possible. It was precisely this defect that lead Descartes to substitute for the ancient methods that powerful instrument of discovery called analytical geometry, which evolved new truths by sheer mechanical procedures alone, and which, by its great success, diverted the minds of philosophers and scientists for nearly two centuries from investigations in pure geometry proper. The new movement began with Monge's work on *Descriptive Geometry* and Poncelet's *Treatise on the Projective Properties of Figures* (1822), in which last work the principles of continuity and reciprocity and the method of projection were used. The successors of these great inquirers were Steiner, Chasles, Von Staudt, and two living authors,—Reye and Cremona.

The real distinction between the old and the new geometry, as represented by the names last mentioned, can be summed up in the fact that while the former was almost entirely metrical, the latter is almost purely positional. For example, in the old geometry we constantly deal with such things as the bisection of segments of straight lines, with right angles and perpendiculars, with ratios, proportions, the computation of areas, and, in its subsequent development, with trigonometric ratios and the algebraic equations of curved lines, all of which involve the idea of measurement. But in pure geometry nothing of this kind is introduced, although its results admit of metrical application. There is no talk of isosceles or equilateral or right-angled triangles, rectangles, regular polygons, etc. The centres, axes, and foci of conic sections "are considered as incidental only to the general theory; but, on the other hand, we are made acquainted with properties of these curves which are more general and more important than those to which most text-books of analytical geometry are restricted." In pure geometry we start with a small number of so-called "primitive forms," and, from the simple relations obtaining between these, proceed to forms of the second order, and so on. The generality and comprehensiveness of the results, which are not based solely on metrical considerations, are such that the most important of the properties of conic sections proved in the text-books of analytical geometry are merely special cases of its theorems.

The preliminary knowledge necessary for the prosecution of synthetic geometry is not great; a profound knowledge of the old geometry is not required; but skill in producing mental images of geometric forms without the use of diagrams is important, as is also a knowledge of perspective or central projection, as well as of descriptive geometry generally. Conversely, the study of synthetic geometry is a great help to the prosecution of the last-mentioned studies themselves.

Its distinctive educational result would be, therefore, to enhance the development of the power of imagination, for which its study can be particularly recommended. The author believes that this is best obtained by the method of Von Staudt which "excludes all calculations, be they complicated or not, which make no demands upon the imagination," and "arrives at the knowledge of the geometric truths upon which he bases the geometry of position, by direct visualisation." But, in absolutely discarding diagrams, and other auxiliaries of the visualising sense, Reye has not followed Von Staudt. He has not sought to increase the difficulties of the subject.

The tendency of all recent educational methods lies in this direction: the utmost development of the powers of sense and consequent imagination. Here lies the basis on which the abstract must build, and the more perfect that basis the more solid will be the superstructure. The most powerful pleas of the greatest of recent mathematicians have been made for "visualisation"; and it is to be hoped that the present beautiful volume will mark, in English-speaking countries also, a distinct stage in the progress towards this goal. T. J. McCormack.

La Géométrie grecque. Comment son histoire nous est parvenue et ce que nous en savons. Essai Critique. By *Paul Tannery*. Première Partie: Histoire générale de la géométrie élémentaire. Paris: Gauthier-Villars. 1887. Pages, 188+vi. Price, 4 fr. 50 c.

Recherches sur l'histoire de l'astronomie ancienne. By *Paul Tannery*. Paris: Gauthier-Villars. 1893. Pages, 370+viii. Price, 6 fr.

The researches of M. Paul Tannery in the history of ancient mathematical and physical science are well known. To call wider attention to his investigations we should like to mention two of his works in this field. The first of the books listed at the head of this notice deals with the traditions which prevailed on the history of geometry among the Greeks. For a knowledge of Greek geometry proper, says the author, we must study the writings of Euclid, Archimedes, Apollonius, and Pappus; but for the history of the science we must go to other sources; and